We claim:

1) A slow wave structure for a traveling wave tube, said structure having:

a beam tunnel having an axis, a beam entrance and a beam exit;

a substrate including a plurality of elongate pins, each said pin having an attachment end and a beam tunnel end, said pins perpendicular to said substrate and said beam tunnel end of said pins located in said beam tunnel, said substrate including an exit aperture perpendicular to said beam tunnel, said elongate pin beam tunnel ends forming a substantially planar surface, said elongate pins having a first depth along said beam tunnel from said beam exit to a first distance from said exit aperture, and a second depth from said first distance to said beam entrance.

2) The slow wave structure of claim 1 where said beam tunnel carries an electron beam.

3) The slow wave structure of claim 1 where said beam tunnel carries electromagnetic waves having a wavelength.

4) The slow wave structure of claim 3 where said first distance is half said wavelength.

5) The slow wave structure of claim 3 where said first distance is (n+1)/2 said wavelengths, where n is an integer greater than 0.

6) The slow wave structure of claim 3 where said elongate pins have a pitch less than 0.1 said wavelengths.

7) The slow wave structure of claim 1 where said output port is an aperture perpendicular to said beam tunnel.

8) The slow wave structure of claim 1 where said pins are arranged in rows perpendicular to said beam tunnel axis.

9) The slow wave structure of claim 1 where said pins are arranged in columns parallel to said beam tunnel axis.

10) The slow wave structure of claim 1 where said pins are arranged in rows and columns, said slow wave structure includes a longitudinal gap equal to one or more said columns, and said exit aperture is centered in said gap.

11) The slow wave structure of claim 1, said structure including a beam shaper having slots aligned with gaps between said pins, said beam shaper having a surface

substantially planar with said elongate pins beam tunnel ends.

12) A slow wave structure for a traveling wave tube, said structure supporting a plurality of wavelengths and having:

a beam tunnel having an axis, a beam entrance and a beam exit;

a substrate including:

a plurality of elongate pins, each said pin having an attachment end and a beam tunnel end, said elongate pins perpendicular to said substrate and said pin beam tunnel ends substantially co-planar with said beam tunnel axis;

an exit aperture perpendicular to said beam tunnel;

said elongate pins having a plurality of step change depths, each step change depth occurring a unique distance from said exit aperture.

13) The slow wave structure of claim 12 where said beam tunnel carries an electron beam.

14) The slow wave structure of claim 12 where said beam tunnel carries electromagnetic waves having at least one wavelength.

15) The slow wave structure of claim 14 where the distance between said step change depth and said exit aperture is half said wavelength.

16) The slow wave structure of claim 14 where the distance between said step change depth and said exit aperture is (n+1)/2 said wavelengths, where n is an integer greater than 0.

17) The slow wave structure of claim 14 where said elongate pins have a pitch less than 0.1 said wavelength.

18) The slow wave structure of claim 14 where said output port is an aperture perpendicular to said beam tunnel.

19) The slow wave structure of claim 14 where said pins are arranged in rows perpendicular to said beam tunnel axis.

20) The slow wave structure of claim 14 where said pins are arranged in columns parallel to said beam tunnel axis.

21) The slow wave structure of claim 14 where said pins are arranged in rows and columns, said slow wave structure

includes a longitudinal gap equal to one or more said columns, and said exit aperture is centered in said gap.

22) An oscillator for radio frequency (RF) waves, said oscillator having:

a beam tunnel formed from a substrate, said beam tunnel having a plurality of elongate pins, said pins having one end connected to said substrate and an opposing beam tunnel end, said elongate pin beam tunnel ends substantially co-planar, said beam tunnel having, in sequence:

a beam tunnel entrance receiving electrons from a thermionic cathode;

a beam tunnel reflection end having a plurality of said elongate pins, said beam tunnel reflection end having one or more reflection regions whereby said elongate pins change depth;

a beam tunnel half wave section with said elongate pins having said first depth;

a beam tunnel exit aperture formed by a gap in said elongate pins;

a beam tunnel gain section with said elongate pins having a first depth;

a beam tunnel exit coupling said electrons to a collector;

said oscillator coupling energy to said exit aperture.

23) The oscillator of claim 22 where said beam tunnel entrance includes an electron beam shaper having a surface substantially co-planar with said elongate pin beam tunnel ends.

24) The oscillator of claim 23 where said beam shaper includes slots parallel to said beam tunnel axis.

25) The oscillator of claim 22 where said beam tunnel carries an electron beam.

26) The oscillator of claim 22 where said beam tunnel carries electromagnetic waves having a wavelength.

27) The oscillator of claim 26 where the distance from said reflection region said pin depth change to said exit aperture is half said wavelength.

28) The oscillator of claim 26 where the distance from said reflection region said pin depth change to said exit

aperture is (n+1)/2 said wavelengths, where n is an integer greater than 0.

29) The oscillator of claim 26 where said elongate pins have a pitch less than 0.1 said wavelengths.

30) The oscillator of claim 22 where said output port is an aperture perpendicular to said beam tunnel.

31) The oscillator of claim 22 where said pins are arranged in rows perpendicular to said beam tunnel axis.

32) The oscillator of claim 22 where said pins are arranged in columns parallel to said beam tunnel axis.

33) The oscillator of claim 22 where said pins are arranged in rows and columns, said oscillator includes a longitudinal gap equal to one or more said columns, and said exit aperture is centered in said gap.

34) The oscillator of claim 22, said reflection region comprising a plurality of pin depths having a plurality of said pin depth changes, each said pin depth change being (n+1)/2 wavelengths from said exit aperture, where n is an integer greater than 0.

35) An amplifier for radio frequency (RF) waves, said amplifier having:

a beam tunnel formed from a substrate, said beam tunnel having a plurality of elongate pins, said pins having one pin end connected to said substrate and an opposing beam tunnel pin end, said elongate pin beam tunnel pin ends substantially co-planar, said beam tunnel having, in sequence:

a beam tunnel entrance receiving electrons from a thermionic cathode;

a beam tunnel input reflection section, said elongate pins having one or more first depths;

a beam tunnel input half wave section with said elongate pins having a second depth;

a beam tunnel input aperture formed by a gap in said elongate pins having said second depth;

a beam tunnel wave section with said elongate pins having said second depth;

a beam tunnel exit aperture formed by a gap in said elongate pins having said second depth;

a beam tunnel half wave section with said elongate pins having said second depth;

a beam tunnel reflection end having a plurality of said elongate pins, said beam tunnel reflection end having one or

more reflection regions whereby said elongate pins change said depth;

a beam tunnel exit coupling said electrons to a collector.

36) The amplifier of claim 35 where said beam tunnel entrance includes an electron beam shaper having a surface substantially co-planar with said elongate pin beam tunnel ends.

37) The amplifier of claim 35 where said beam shaper includes slots parallel to said beam tunnel axis.

38) The amplifier of claim 35 where said beam tunnel carries an electron beam.

39) The amplifier of claim 35 where said beam tunnel carries electromagnetic waves having one or more wavelengths.

40) The amplifier of claim 35 where said beam tunnel carries electromagnetic waves having a plurality of wavelengths, and said input reflections section includes a plurality of said pin said first depths which have an

associated $F_{maximum}$ which exceeds at least one of said wavelengths.

41) The amplifier of claim 40 where the separation between said input aperture and the change from said second depth to said one or more first depths is (n+1)/2 said wavelengths for at least one said wavelength, where n is an integer greater than 0.

42) The amplifier of claim 39 where said elongate pins have a pitch less than 0.1 of at least one of said wavelengths.

43) The amplifier of claim 35 where at least one of said input aperture or said output aperture is an aperture perpendicular to said beam tunnel.

44) The amplifier of claim 35 where said pins are arranged in rows perpendicular to said beam tunnel axis.

45) The amplifier of claim 35 where said pins are arranged in columns parallel to said beam tunnel axis.

46) The amplifier of claim 35 where said pins are arranged in rows and columns which include a longitudinal

gap equal to one or more said columns, and said exit aperture is centered in said gap.

47) The amplifier of claim 35, including a beam shaper having slots aligned with gaps between said pins, said beam shaper having a surface substantially planar with said elongate pins beam tunnel ends.